Final Report

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FUNDAMENTAL MATHEMATICS CONCEPTS FOR PHYSICALLY HANDICAPPED STUDENTS: THE FOCUS IN MATHEMATICS PROGRAM

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Abstract

The principal objective of this project was the development of instructional guides, with manipulative materials, to establish a content base for improving instruction in fundamental mathematics for legally blind students. Needs of three categories of blind students were addressed: academic legally blind students who are mainstreamed, legally deaf/blind students, and legally blind students with additional handicapping conditions which interfere with learning. Project objectives include consideration of entry-level needs of young students and remediation needs of older students in fundamental mathematics. The program considers prerequisites for achieving success in mathematics. The prerequisites are defined in terms of Fundamental Operations and Concepts and their Underlying Schema (FOCUS) which provide an information base and a structural framework for studying mathematics. Educators who have used the program have endorsed its functional applications for assessment, for diagnosis and prescription, and for remediation. The program begins with prenumber activities which students can perform as early as kindergarten. The sequential development of number emphasizes fundamental operations, structures, and properties. The operations introduced are addition, subtraction, multiplication, and division. Also introduced are the concepts of time, money, charts and graphs, geometry, and fractional quantities. The program was evaluated by teachers with legally blind students in 29 classrooms in nine states plus the District of Columbia, and is appropriate for residential, institutional, or mainstreamed programs whether regular class, self-contained, resource, itinerant or homebased. The three editions of the FOCUS in Mathematics program are produced and disseminated by the American Printing House for the Blind, P.O. Box 6085, Louisville, Kentucky 40206.

Introduction

Background

A consistent retardation of about 20% in achievement in mathematics among the blind population has been reported (Hayes, 1941; Nolan & Ashcroft, 1959). Brothers (1972) found that overall achievement of braille students in 1970 scored approximately 27% below the sighted norm.

Coker (1980) examined Stanford Achievement scores of 40 students in grades 3-6 in a sample stratified to approximate the general population. He found that academic achievement of visually handicapped students enrolled in residential schools and in day school programs did not differ at third grade. Mean scores for both groups, however, progressively decrease, and by sixth grade they are slightly below grade level. Scores indicated that the total sample was below grade level in mathematical concepts, mathematical computation, social science, and spelling. Academic scores declined for day school students from grades 4-6, and by grade 6 day school students were significantly behind in academic achievement.

A study by Willis (1980) on performance in mathematics by 370 legally blind students in grades 2-10 on the Stanford Achievement Test (Primary Batteries II and III, Intermediate Levels I and II) also confirmed performance below grade level. If a generalization is to be made concerning this population, it is that blind students are consistently low achievers in mathematics.

Needs in Mathematics

Fundamental mathematics concepts are critical since they form the foundation for the mastery of basic operations at all grade levels. Many of these are science related. Much information in primary, elementary, and junior high mathematics texts is presented or introduced schematically and is of questionable value to the legally blind. Consequently, there is a great need to develop manipulative materials and/or alternative procedures for establishing a content base as early as possible if blind students are ever to approach performance at grade level in mathematics. It is believed that many conceptual deficiencies still exist at the upper elementary and secondary grade levels where they are masked by partial content mastery and by the facility of blind students to verbalize (Cutsforth, 1933; Harley, 1963) conceptual information which they do not fully comprehend. Splinter skill acquisition may well underlie poor performance in mathematics by blind students at all grade levels. The instructional problems of blind students (including those with such additional handicapping conditions as severe hearing losses and

academic retardation) can be addressed once a base of fundamental mathematics concepts is established.

A needs meeting in mathematics (Franks, 1980) was held at the American Printing House for the Blind in Louisville to examine areas in mathematics where deficiencies in instructional materials for visually handicapped exist, to identify specific aids necessary for teaching basic concepts in these areas, and to suggest priorities for the development of relevant aids and materials. Six mathematics teachers of blind students participated. They emphasized the need for materials that could help these students progress from the concrete in the environment to abstract representation in braille textbooks.

In 1978, six mathematics content experts of national stature were asked by the American Printing House to prioritize mathematical concepts and operations in order to identify those which are critical to the understanding of mathematics processes. The following experts participated:

Dr. Grayson H. Wheatley, Professor
Mathematical Sciences Building
Purdue University
West Lafayette, IN 47907

Dr. E. Glenadine Gibb, Professor
Mathematics Education Department
RLF-8-100
The University of Texas at Austin
Austin, TX 78712

Dr. Evelyn M. Neufeld, Associate Professor
School of Education
San Jose State University
San Jose, CA 95192

Dr. Jack Price, Superintendent
Vista Unified School District
Vista, CA 95192

Mr. George Immerzeel, Director
Price Laboratory School
University of Northern Iowa
Cedar Falls, IO 50613

Dr. Arthur Kessner, Coordinator
Elementary Mathematics Concepts with Calculators (EMC^2)
Lawrence Hall of Science
University of California
Berkeley, CA 94720

Subsequently, a national meeting in mathematics needs of blind students was held in Louisville July 6-8, 1979. Ten expert teachers of visually handicapped students in day and residential school programs participated in the sessions. Teachers included secondary mathematics teachers of blind students, elementary grade teachers of mathematics, resource teachers, itinerant teachers who teach and assist visually handicapped students, and primary and early childhood teachers who work with visually handicapped students. One blind college student who attended public school was included to present the student point of view. Two of the participants were blind mathematics teachers.

The purpose of the meeting was to identify mathematics aids and materials that would be needed by visually handicapped students in performing fundamental operations. Participants used the concepts assessment information compiled from the content experts' priority listing. They established as the highest priority the development of entry-level, primary grade materials which are designed to introduce and teach concretely basic math concepts and operations.

Project Objective

The principal objective of this project was the development of instructional guides, with manipulative materials, to establish a content base for improving instruction in fundamental mathematics for legally blind students. Needs of three categories of blind students were addressed: academic legally blind students who are largely mainstreamed, legally deaf/blind students, and legally blind students with additional handicapping conditions which interfere with learning. Project objectives included consideration of entry-level needs of young students and remediation needs of older students in fundamental mathematics.

General Program Description

The importance of the FOCUS in Mathematics program is the attention that it gives to determining knowledge and skills required of students in order to begin mathematics study. In a manner of speaking, the program considers prerequisites for achieving success in mathematics. The prerequisites are defined in terms of Fundamental Operations and Concepts and their Underlying Schema which provide an information base and a structural framework for studying mathematics.

While the program is not a teaching program, educators have endorsed its functional applications for assessment, for diagnosis and prescription, and for remediation.

The program begins with prenumber activities which students can perform as early as kindergarten. These prenumber activities introduce naming, matching, classifying, comparing, and ordering through use of common objects and exploration of their attributes, properties, and numerousness. The sequential development of number emphasizes fundamental operations, structures, and properties. The operations introduced are addition, subtraction, multiplication, and division. Problem solving activities reinforce these operations. Additional mathematics concepts include the introduction of time, money, charts and graphs, geometry (basic shapes, plane shapes, raised line shapes and figures), and fractional quantities.

Generally, educators have used the program in three ways in their efforts to improve mathematics instruction.

1. Assessment. The materials were designed to identify deficits in knowledge of fundamental operations and concepts which underlie performance, mastery, and comprehension of basic operations and skills. Teachers utilize the identification of concept deficits and splinter skills to provide focus for instruction in fundamental mathematics.

2. Diagnosis and prescription. The sequential and systematic progression of activities in small, easily assimilated steps enhances the application of diagnostic/prescriptive techniques in instruction. Particularly, teachers use these techniques in the early grades where appropriate curriculum materials do not exist for young visually impaired students. Teachers diagnose deficits and prescribe, or write, activities to teach the concepts or skills where students demonstrate weaknesses.

3. Remediation. The tractability of the program enables the teacher to develop intervention strategies for remediating cognitive skills. Teachers can extend use of the sequence with older students to put these concepts and skills into a fundamental mathematics perspective and to establish a content base for further mathematics instruction.

The following summary statements further identify and describe instructional features of the program.

1. The program is appropriate for residential, institutional,

or mainstream programs whether regular class, self-contained, resource, itinerant or home-based, with implications for use by paraprofessionals and parents with teacher supervision.

2. The materials are activity oriented and curriculum-based with instructional activities and manipulative aids.

3. The program has potential for self-pacing which fosters an individual learning style; presents activities sequentially in small, easily assimilated steps; involves active student participation; and affords immediate reinforcement through performance feedback.

4. The activities content addresses entry-level concepts that have been identified as critical by expert mathematics educators.

5. Initial instruction begins with the familiar or concrete and moves to the abstract--from the object to the symbol.

6. As the program proceeds, the increments or steps increase when cognitive skills (prenumber activities) are internalized.

7. The activity sequence incorporates models or patterns for introducing use of the braille code in performing fundamental mathematics operations.

8. The structure and presentation of the activities promote language development.

9. The mechanical and the mathematics related skills of reading and writing augment and parallel the regular reading program.

10. Selected activities in group settings promote communication and social interaction among students.

11. The program emphasizes use of mathematical terms (vocabulary) which are prerequisite to the development of scientific literacy.

12. Verbalization of mathematical relationships in answering such questions as "How do you know?" encourages scientific inquiry.

13. Application sections extend entry-level concepts into daily living.

14. Manipulatives and instructional materials utilize color and visual contrasts to maximize use of residual vision by low vision students.

15. The FOCUS Content Outline enables the teacher to compare the mathematics content with that of curriculum materials used in the classroom.

16. A section with suggestions on preparatory activities, body awareness, and spatial orientation is included for young blind students who may require this instruction.

17. The kit of manipulative aids includes a list of the contents. The aids are labeled and are specified under MATERIALS in each activity.

18. The instructional activities guidebook enables the teacher to record performance information for several students in a class or school program. However, the teacher may wish to utilize single copies to maintain individual records of progress for young visually impaired students who require specially edited activities and practice materials.

The integral component of the program is the Checklist of Instructional Objectives which is based on concepts and skills that provide the foundation for performance, mastery, and comprehension of fundamental mathematical operations at all grade levels. The Checklist, and accompanying curriculum-based materials, are designed to provide a content base in entry-level mathematics. Spaces on the Checklist enable the teacher to record data and notes on student performance. Flexibility in use of the materials is actuated through the substitution of manipulatives and throuh editing of the instructions to meet specific student needs. The Checklist affords selectivity in deferring the presentation of concept modules. It provides information critical to the preparation of Individual Educational Plans. The Checklist promotes use of the materials as a supplementary curriculum aid through identification of concepts and skills which require instruction and/or additional practice. Although there is considerable adaptability in use of the materials, the objectives which compose the Checklist must remain intact and unchanged. The teacher must exercise caution when substituting manipulatives and/or editing activities to retain the original context and content of the objectives since they provide the structural framework for the program.

Another important program feature is the Application sections following the activities modules. The applications emphasize mathematics based activities which enable the teacher to focus on the relevance of the concepts in daily living, to facilitate prevocational entry through manipulation and laboratory-type experiences with objects, to inaugurate the use of appropriate vocabulary as a prerequisite to scientific literacy, to promote social interaction among students, to increase the interest of talented students in career exploration and planning, and to provide opportunities for paraprofessional and parent involvement.

Special Edition for Multihandicapped Blind Students

This loose leaf edition of the FOCUS in Mathematics program for multihandicapped students emphasizes adaptations for individual use. Teacher evaluations and in-depth analyses of student performance revealed such disparity in specific needs that varying levels of rewrite and adaptation are anticipated for the majority of these students with severe handicapping conditions. Adaptation of activities is possible through use of the CONTEXT SPECIFIC RESPONSE/ DATA SHEETS which can be inserted wherever needed. Particular care is essential to insure that the content objectives remain intact. An individual copy of the program for each student is recommended.

The special categories included on the RESPONSE/DATA SHEETS facilitate the tractability of the program. These categories are: stimulus channels, orientation, stimulus materials, and vocabulary. The stimulus channels include the auditory, the visual, the gustatory, the olfactory, and the kinesthetic modalities. Once the appropriate channels are identified for an activity, they should be optimally stimulated and the activity adapted accordingly. When the task or activity changes, a new stimulus activity channel inventory may be required. The tactile channel includes the sense of pressure and temperature over the body surface. The kinesthetic modality refers to the more common types of gross and fine motor movement (e.g., a movement of the arm or body, bending, lifting, picking up small objects, and a sense of vibration) and to vestibular sensations (e.g., balance, turning, the internal sense of the body's direction, and uprightness). The gustatory and olfactory modalities involve detailed inventories of smells and tastes to which the student responds. It is important that the inventory for smell and taste includes the strength or weakness of the stimulus (e.g., food, flowers, perfume) since multihandicapped students are frequently overly sensative or insensitive to many stimulus items. The most important consideration concerning the auditory modality is the overlap of auditory stimulation with the kinesthetic to reinforce

audition with vibration. The primary visual concern is the appropriate selection of circumstance and materials to maximize stimulation of residual vision. The establishment of the student's most receptive channels of communication is critical. Are they tactile, auditory, visual, gustatory, olfactory, or kinesthetic? Are they a combination of channels? Which channels are damaged, which are intact?

For many multihandicapped students there will be gaps in the overall functional profile. Represented on a graph these gaps appear as an irregular saw-tooth line indicative of the development typical of the multihandicapped blind. The varied and inconsistent performance of these students as a group underscores the need for an individually tailored program. Frequently, multihandicapped blind students have learning impairments and information processing difficulties above and beyond those made obvious by their physical impairments. Some sections of the FOCUS program may require much repetition using a variety of presentations.

If a student appears to have achieved competency on an activity and fails on the next--that is, the student accomplished Activity 5, but fails on Activity 6--the teacher may assume that the performance indicates "skips" or "gaps" in learning. The suggested procedure is to return to the previous activity, further break it down, slow it down, and employ a variety of stimulus modes as needed.

Environmental orientation has long been recognized in the education of the blind as a major area of concern. The multihandicapped student frequently has "context specific" learning behaviors. These behaviors underlie the need to relearn concepts of orientation for each task. Relevant environmental and work area components should be established and reestablished with each change or task variation.

Perhaps the most important single concern once stimulus channels have been discerned and orientation confirmed is the use of the FOCUS stimulus materials included in the kit or those selected from the environment. Because of the uniqueness of the individual's learning style created by the combination of impairments, an equally unique and idiosyncratic group of materials and techniques may be necessary to present and to expand the FOCUS concepts (e.g., using musical instruments to teach more and less, colored lights to teach same and different, or food to teach large and small).

Language difficulties arise at all levels. It is important to teach language/vocabulary to the student prior to presenting the

mathematics concept. Students will require exploration, manipulation, and identification of many stimulus materials included in the program (e.g., balls, caplugs, corks). Such simple words and instructions as "things" and "hand me" may require teaching/learning. FOCUS mathematics terminology should be employed where possible.

Special Edition for Deaf/Blind Students

While the FOCUS materials have been enthusiastically received by teachers working with blind students having the additional handicap of a hearing loss, a number of suggestions have resulted in a special edition. The revised format is briefly described below:

1. Establishing Rapport

   Some suggestions are offered to teachers for the purpose of establishing a comfortable rapport. Teachers should be familiar with the students' communication skills, desired modalities (sign, fingerspelling, braille, oral communication, etc.) and behavior patterns. Informal conversation should precede the lesson activities when possible to establish a relaxed learning atmosphere. With low functioning and/or very young students, one word utterances should be considered beginning conversations.

2. Communication

   The range of possible communication skills a teacher may encounter is broad. It is suggested that teachers reduce verbage as much as possible. Elementary concepts can be presented in basic sentence patterns. The revised version of the FOCUS materials for deaf/blind students includes many suggestions for emphasizing the basic vocabulary of the lessons. Space is provided for keeping records of when and how the individual student acquired a key vocabulary word. There is space for recording secondary vocabulary as well. It is important to reinforce this acquisition of language by consistently using it in subsequent activities. Occasional reviews will prove helpful. Parents, staff, and students are encouraged to use the newly acquired vocabulary as much as possible. Through this exposure, the effectiveness of the FOCUS program will be enhanced.

The questions to be asked to the student during each activity have been written in two forms. One form approximates American Sign Language syntax. Depending on a teacher's skill and experience and

the student's communicative strengths, one of these versions, something in between, or a more basic approach may be appropriate. The teacher needs to continually keep in mind that mastery of an objective may have been realized but the assessment of mastery may be clouded by the communication process. Every effort to communicate effectively in a mode compatible with the student's skills and preferences is encouraged.

Illustration of key signs also have been added to this special edition. Teachers have requested these illustrations to facilitate the communication process. Communicating with deaf/blind children, however, involves much more than knowing the signs. It is preferred that a teacher be experienced with manual communication prior to beginning with the FOCUS materials with deaf/blind students.

Additional sign language references are listed in the bibliography of this special edition. Students should learn the spelling of the words as well. At times, the sign for a word (e.g., circle) may give away the shape you are asking the student to identify. Use of both the signed and fingerspelled versions are encouraged to assure that mastery has been achieved.

Orientation. The emphasis on orientation is crucial. Deaf/blind students have had restricted experiences with objects in their environments. They should be oriented to the stimulus objects used in the program, in particular. The student should be able to identify and describe such objects as "blocks" and "cylinders," for example, before using them in a lesson. Preferably, they should know the sign and spelling of these terms as well.

The teacher is encouraged to begin with concrete experiences and to familiarize the student with all materials and with the language used in each lesson. This "pre-teaching" phase is most important. After the objective appears to have been mastered, a follow-up with a "post-teaching" phase is recommended again using concrete objects. This time, the student is aided in transfer to self and the environment. Applications to living and orientation to self will reinforce the learning task that has occurred. The applications give relevance to what has been learned and provide the student with a sense of fulfillment when meaning is emphasized. Again, parents and teachers should be kept informed when possible on the new mathematical concepts and the parallel language skills so that they may make efforts to provide reinforcement at other times.

Teachers need to capitalize on whatever residual hearing and vision the student may have. Combined sensory losses introduce formidable challenges to learning. There is a strong need for the teacher to be thoroughly familiar with the assessment/advising process. The degree of the losses, age of onsets, and other factors have implications for how the mathematical and language competencies can be taught. There is an equally strong need for the teacher to be thoroughly familiar with the FOCUS materials before beginning.

Activity format. Each activity begins with an OBJECTIVE which describes the goal or purpose of the experience. MATERIALS correspond to the prepackaged activity supplies which accompany the FOCUS manual.

Many of the activities begin with an ORIENTATION which provide teachers with suggestions for preparing the student for the activity. PRIMARY VOCABULARY words are those which are fundamental to the objective. These are key terms which are crucial to mastering the underlying lesson concepts. SECONDARY VOCABULARY terms include any new words the student learns in the process of completing the activity. Teachers are encouraged to keep records of these vocabulary terms in order to enhance learning by the student through continuous reinforcement.

Because the language skills of the students will vary widely, the MASTERY CHECK includes two versions of the question teachers should ask. Version 2 is for students with minimal language skills. Experiment with different versions and try to find a level commensurate with the students' abilities. Then slowly provide more challenging linguistic structures while progressing through the activities. In this way, language development may be interwoven with the gradual learning of the fundamental operations and concepts and their underlying schema.

When special modifications of the activity are necessary, the teacher is to keep notes in the MANIPULATION REQUIRED and ADAPTATION REQUIRED sections. This will help other professionals and parents in understanding the students' special needs as well as in seeing the progress made through time in mastering the objectives.

Materials Development and Evaluation

The materials development and evaluation consisted of the preparation of manipulative aids, drafting of the instructional activities which included formative evaluation with blind students, review of the mathematics content by mathematics experts, critiques by specialists in education of handicapped students, evaluation of the program by teachers with blind students, and use of the revised prenumber sections of the program with young blind students by the project director and the project assistant.

Preparation of Manipulative Aids

Manipulative aids were identified for specific hands-on use with each instructional activity. Where possible, objects in general use in the classroom were selected. Adaptations of aids were made when necessary to increase their tactual legibility and to maximize color contrasts. A parts list of aids in the kit and the activities with which each is used is included in Appendix A.

Drafting the Instructional Activities

Sequential activities were drafted following guidelines from the prioritized list of mathematical concepts and operations by experts reported earlier. The resulting guidelines appear as a Checklist of Instructional Objectives upon which the program is constructed. The 177 objectives are presented in modules and include applications. Each activity was used with students and was rewritten as required to increase its appropriateness and usability. Chart 1, Activity Development/Preparation Process, details the procedure.

CHART 1

Activity Development/Preparation Process

Analysis/Sequencing of Concepts/Skills

1. Sequencing concepts and skills from the priority list

2. Filling in concepts/skills required by blind students

3. Including "new" emphasis activities (e.g., problem solving, estimation, application)

4. Other

Incorporation of results from the Willis Study

1. Review of activities to identify "general" deficiencies related to the Scholastic Aptitude Test

2. Identifying and prioritizing specific deficiencies in the sequence

a. Deficiencies related to Scholastic Aptitude Test structure

b. Deficiencies related to mathematics

c. Deficiencies/Needs which related to braille and to Nemeth code

d. Other

3. Other

Writing and Sequencing Objectives

1. Development for sequencing by categories (e.g., Computation, geometry)

2. Review of appropriate language and math vocabulary (Scientific Literacy)

3. Other

Identifying and Reviewing Tangible Aids and Manipulatives

1. Preliminary identification of "traditional" aids

2. Rewrite/edit/development of alternative instructions/techniques/methods of presentation to facilitate instruction/selection of manipulatives

3. Notation of potential adapted aids which APH can produce

4. Other

Preparation of a Draft of Instructional Objectives

1. Preliminary draft of objectives, by module and by sequence

2. Designation of gaps in mathematics concepts, additional needs/deficiencies indicated from Scholastic Aptitude Test results, needs in language/vocabulary, in braille code, and other

3. Notation of unresolved problems relating to previous categories

When a tentative format was selected, 30 activities were prepared and the format and instructional activities were reviewed/critiqued by content experts and educational specialists monitoring the project. Their recommendations and suggestions were considered in finalizing the program format and in completing the instructional activities.

Periodic writing sessions were conducted with the co-authors to monitor/review/draft the field evaluation edition of the instructional activities.

Review of the Mathematics Content

The mathematics content was reviewed and monitored by the following experts of national status who examined the materials to confirm that the content and activities are appropriate and mathematically sound.

Dr. E. Glenadine Gibb, Professor of Mathematics
The University of Texas
Austin, Texas 78712

Dr. Evelyn Neufeld, Professor
School of Education
San Jose State University
San Jose, California 95192

Critiques by Specialists

Critiques were performed by specialists in the education of handicapped students in science/mathematics, including representative specialists who themselves are blind, deaf, and physically handicapped. The following specialists participated.

Dr. Ann Swanson, Chairman
Department of Physical Science
Edgewood College
Madison, Wisconsin 53711

Mr. Richard V. Morris, Multihandicapped Blind Specialist
Programs for Handicapped
San Diego City Schools
6404 Linda Vista Road
San Diego, California 92111

Dr. Harry Lang, Professor
National Technical Institute for the Deaf
Rochester Institute of Technology
One Lomb Memorial Drive
Rochester, New York 14623

Dr. Daniel D. Burch
Independent Living Center for the Deaf, Inc.
3808 Tulane Avenue
New Orleans, Louisiana 70119

Mr. Anthony Evancic
Western Pennsylvania School for Blind Children
201 North Bellefield Street
Pittsburgh, Pennsylvania 15213

Dr. Tuck Tinsley, III, Principal
Florida School for the Deaf and Blind
San Marco Avenue
St. Augustine, Florida 32084

Evaluation by Teachers

Of the 29 teachers invited to participate, 26 teachers of more than 100 academic blind, legally deaf/blind, and multihandicapped blind students in day school and residential programs in 9 states actually completed and returned their field evaluation of the project materials. The evaluation was a teacher critique based on student performance. Because of the concern with how students learn concepts and how far they can progress through the program, the evaluation emphasized concentration on and in-depth work with smaller numbers of students than in studies where empirical data are collected. Teachers noted adaptations needed and suggested alternative activities relative to specific handicapping conditions as each affects learning.

Each evaluator was asked to use the program with three to five students, depending upon availability and upon severity of handicapping conditions. In an effort to maximize evaluation of all the activities in the program, teachers involved additional students in the evaluation when participants had gone as far as possible because of additional handicapping conditions, the maturity level of the students, and/or because extensive instruction and remediation were required. A number of students who were classified as braille readers used vision in performing some of the tasks. Teachers reported varying the same activity

with different students in several instances. Most teachers made minor adaptations or variations which did not require editorial changes. As teachers progressed through the program, they suggested fewer changes in the activities.

On-site observations and interviews were conducted in the evaluation of activities. The procedure usually resulted in two or more sessions. During the first session the Project Director reviewed the activities manual for changes suggested by the teacher. In a subsequent meeting, each change was discussed and specific changes were incorporated in a composite activities manual. In these discussions, the teacher often reflected on an activity and modified or discounted a suggested change or editorial comment. In a number of instances they reported that activities could be "individualized"--as they would do with regular text or curricula materials--without editing an activity.

Additional information is provided in the Discussion section. Specific suggestions and comments on editions for multihandicapped blind and on deaf/blind students also are presented in the Discussion section.

Use of the Revised Program

As reported, the sequence of mathematics conceptual information and the sequence of instructional activities were reviewed by content experts and by experts in education of handicapped students. Although no concept modules were shifted in the program, a number of editorial changes based on feedback from teacher evaluation resulted. There also was concern because teacher evaluators often used a variety of students in order to evaluate all of the activities. They tried different adaptations of the same activity with students. A number of students were ungraded and in classes where grades were assigned according to a student's reading level. When a grade was assigned that indicated reading level, teachers reported that students often were not functioning on that grade level in mathematics.

In an effort to confirm appropriateness of the revised instructional activities--particularly in the prenumber entry-level sections--the project director and the project assistant used the prenumber sections of the program with 18 legally blind students in K-3 in a residential setting where students were assigned to specific grade levels. A distribution of students is presented in Table 1.

Table 1

Distribution of Students

Grade	n	% Male	% Female	% Visual	% Tactual
K	5	60.0 (3)	40.0 (2)	60.0 (3)	40.0 (2)
1	4	75.0 (3)	25.0 (1)	75.0 (3)	25.0 (1)
2	3	100.0 (3)	0.0 (0)	66.7 (2)	33.3 (1)
3	6	66.7 (4)	33.3 (2)	50.0 (3)	50.0 (3)
Total K-3	18	72.2 (13)	27.8 (5)	61.1 (11)	38.9 (7)

Student performance on the revised instructional activities indicated that the editorial changes were appropriate and had improved the overall clarity of instruction. Students at the K-1 grade levels proceeded smoothly through those prenumber activities designed to confirm internalization of age-appropriate concepts in the early stages of cognitive development. Older students in grades 2-3 moved rapidly through the prenumber and number sections to the more advanced mathematical concepts consistent with their level of instruction in the school's mathematics curriculum. However, gaps and splinter skill acquisition of prenumber or entry level concepts by both younger and older students were diagnosed and remediated.

Discussion and Summary

The following summaries are based on interviews with some 25 teacher/evaluators conducted during the project. The information presented emphasizes the categories upon which there was general agreement. Specific comments on evaluations of the multihandicapped edition and the deaf/blind editions also are summarized.

Overall Program and Content Organization

Accurate entry level mathematics concepts, appropriate instructional activities, and reasonable length of program were considered critical. Teachers were generally positive in their response to the following items:

1. The instructional objectives address critical entry-level concepts, skills, and operations.

2. The objectives are reflected in the instructional activities.

3. The instructional activities are sequenced in mini-modules (e.g., SAME AND DIFFERENT).

4. The instructional activities follow a logical progression from simple to complex number operations.

5. The instructional objectives are applied at the end of each mini-module.

6. The presentation and sequence of activities follows clearly the overall program organization.

Teachers questioned sequencing of some activities in the program, particularly teachers of deaf/blind and multihandicapped blind students. However, no one suggested reorganization of the concepts. Prenumber concepts (e.g., same, different; heavy, light; more, less) were presented prior to number to avoid introducing them and number relationships (e.g., the number more than 3, the number less than 5) at the same time. Many number concepts, however, could have been introduced earlier if the selection had been on content difficulty alone. However, the use of tactile aids which were considered to increase overall difficulty level was a consideration.

Teachers utilized the checklist of instructional objectives as a reference when they wished to vary concept module sequence, particularly with students who knew some of the concepts (e.g.,

recognizing numerals 0-10, counting numbers/objects to 20) and with students who needed a change in activities or concepts (e.g., days of the week, time, money).

Instructional Activities

Teachers responded affirmatively to the format of the instructional activities. They indicated that the activities:

1. state adequately the instructional activity.

2. present tasks which underlie entry level operations/ concepts/skills in mathematics.

3. break down the tasks to facilitate their introduction/ presentation.

4. provide essential information to the teacher.

5. express clearly the suggested instructions to the student.

They were pleased with the number and variety of manipulatives included and with the activities which drew on concrete objects in the environment. They were emphatic in statements that the manipulatives included were valuable and saved a great deal of time. They noted that a number of the materials were specially designed and would be very difficult or impossible for the teacher to provide. No teacher suggested that any of the manipulatives be deleted. They did suggest that those items to be supplied by the teacher be more clearly specified. In response, a list of materials which identifies items used with each activity is included in each kit.

Manipulative Materials

Although teachers were pleased with the manipulatives included in the kit, they suggested their reorganization to make them easier to find. Suggestions included:

1. Include an inventory list of all components.

2. Attempt to group the aids considering the sequence in which they are used or presented.

3. Consider stacking trays or drawers to hold the objects.

4. Use commercial grade see-through plastic bags when appropriate.

5. Select specific terms for specific materials (e.g., plastic/thermoform sheets, cards).

These items were addressed in finalizing packaging. An inventory of aids and materials has been included, prenumber items are placed together in a tray, heavy see-through plastic bags are utilized extensively, specific terms (e.g., cards, sheets) are used to aid in location of print and braille materials, and a breakdown of additional American Printing House aids (e.g., braille clockface sheets, shape board, set of fractional parts of wholes) to extend concepts is included.

Applications

Teachers were enthusiastic in their response to the APPLICATIONS sections at the end of each of the activity modules. These sections enable the students to apply basic mathematics concepts (e.g., identify, classify, order) in their immediate environments. Items in this category include:

1. The APPLICATIONS sections extend the prenumber concepts into daily living and into prevocational dimensions.

2. These applications utilize mathematics based activities to promote daily living skills.

3. These applications also utilize mathematics based activities to provide entry level prevocational experiences.

4. These prenumber applications should be extended in this program. (If you answer "Yes" to this or the following items, please comment or explain.)

5. A mathematics based daily living program should be developed.

6. A mathematics based prevocational program should be developed.

Suggestions included:

1. The development of a second level proceeding from the entry level concepts to higher level activities with money,

time, measurement, graphs, fractions, and greater emphasis on computation was the most recurring request.

2. The development of a prevocational program or modules in mathematics for older students, with focus on the use of simple mathematics related to such activities as making purchases, using and counting money, and simple budgeting was requested.

3. The preparation of mathematics based daily living program for the lower functioning student who can master simple addition and subtraction operations.

Teachers across the three categories supported the development of a curriculum-based daily living program and a curriculum-based prevocational program. They were unanimously positive on Items 1-3. Teachers of students with even low academic potential were positive in their responses to Items 4-6. However, teachers of advanced students were more concerned with "extending" the program in terms of a "second level" with more emphasis on fundamental operations and on computation. Teachers of multihandicapped and deaf/blind students leaned toward an "applications" focus with less formal mathematics presentation.

Multihandicapped Edition

The edition for multihandicapped blind students was evaluated by 12 teachers. More teachers were included in the evaluation because of the wide range of differences in students and because highly successful multihandicapped students function more like academic students. These teacher evaluators also were enthusiastic about the program. They observed, however, that no two students--even with the same handicapping conditions--functioned or performed the same. The immediate response from teachers was the need for an individual manual or guidebook for each student and considerable space for writing in individualized adaptations. Teachers felt that they could work from the information included in the evaluation manual if it were broken down and if space was provided for further adapting the activities.

The various categories of items suggested were analyzed and a decision made to provide this edition in a loose-leaf binder with special Context Specific Response/Data Sheets providing space for adaptations. As many of these sheets as needed can be inserted with the appropriate activity in the program. A manual for each student will provide an individual and on-going record of progress in

mathematics and will include the specific adaptations required for each activity. The Context Specific Response/Data Sheet includes space for rewriting an activity, blanks and space for specification of and notation on stimulus channels (e.g., tactile, auditory, kinesthetic), blanks and notations for environmental orientation needs, and space for identification and practice with stimulus materials (the aids and materials used in the program) prior to their use in an activity. A wide range of manipulation and perceptual problems accompanying the visual loss further complicates instruction for a great number of these students. A copy of the Context Specific Response/Data Sheet is included at the end of this section on page 24.

Numerous secondary handicaps severe enough to affect learning were reported by teachers. Among those recurring most often are the following. They are not listed in order of number of times reported. In several instances one of these may have been the primary handicap although (legal) blindness was reported as the major handicapping condition.

- Cerebral palsy
- Educational retardation
- Brain damage
- Learning disorders
- Seizures
- Speech and/or language disorders
- Motor involvements (including ambulatory students)
- Autistic behavior
- Diabetes
- Hemiplegia
- Environmental deprivation
- Emotional disturbance
- Academic delayed
- Spina Bifida
- Multiple Sclerosis
- Aphasia
- Deafness (as one of several handicapping conditions)
- Pituitary dwarfism
- Perceptual problems

Deaf/Blind Edition

The edition for deaf/blind students was evaluated by seven teachers who used the program (or relevant sections) with students from the kindergarten to the secondary grade level, in day school and in residential school settings. Decisive additions/adaptations made in the program as a result of the evaluation are: the inclusion of a second verbal version of instructions to deaf/blind students, differentiation between primary (e.g., same, different) and secondary (e.g., cork, block) vocabulary, the addition of sign illustrations (e.g., tall, short) for critical mathematics terminology, and a breakdown of entry level vocabulary by category (e.g., concrete materials, verbs).

CONTEXT SPECIFIC RESPONSE/DATA SHEET Activity/objective#_____

STIMULUS CHANNELS (Identify primary channels with number 1 and secondary channels with numbers 2 or 3.)

_____ Tactile _____ Visual _____ Olfactory

_____ Auditory _____ Gustatory _____ Kinesthetic

ACTIVITY ADAPTATION (Use the back of this sheet to rewrite or adapt the activity.)

CHECK EACH ITEM OR RECORD DATE WHEN IDENTIFIED OR MASTERED BY THE STUDENT.

ORIENTATION (List critical locational and directional referents used in performing the activity.)

In the work area	In the environment
_____	_____
_____	_____
_____	_____
_____	_____

STIMULUS MATERIALS (List critical objects and materials used in performing the activity.)

From the kit	From the environment
_____	_____
_____	_____
_____	_____
_____	_____

VOCABULARY (List critical vocabulary and mathematics terms used in performing the activity.)

Activity related	Mathematics terms
_____	_____
_____	_____
_____	_____
_____	_____

COMMENTS (Make additional comments on back.)

DATES

_____ _____ _____ _____
1 2 3 4

Two teachers in a day school program worked with 2-4 (nongraded) students at entry level for more than one year in developing procedures/techniques for introducing prenumber concepts in the FOCUS mathematics program. This was an ambitious undertaking considering that the students were still learning basic personal and self care skills, had not developed substantial communication skills with either speech or manual communication, and had little previous experience with many of the instructional materials used in the FOCUS program. The teachers utilized a team approach with the first presenting language concepts and the second introducing mathematics concepts when essential language concepts were mastered. Sometimes FOCUS materials were used to teach language and later used to teach mathematics concepts. To reduce the number of new variables, activities often were adapted using materials and objects with which students were familiar. Many activities were further broken down into smaller increments. Instruction included constant (daily) remediation. Basic language concepts were reinforced by teacher aides and by parents.

As communication and basic mathematics skills increase, teachers report greater progress in computation and success in performing mathematics operations. Word problems, however, seem to pose a problem for many legally deaf/blind students, even for higher functioning students. One teacher suggested the following daily class schedule: 5 minutes with flashcards, 10 minutes on a word problem, 5 minutes reviewing past skills, and 20 minutes on a new skill. All teachers reported the use of a variety of class activities, each of relative short duration, to maximize maintaining the students' attention span. Another difficult task reported was "rounding off" numbers. Teachers were able to use the program with considerable adaptation and breaking down of activities. Their primary suggestion in this regard was the stringent reduction of language (used by the teacher to the student) to accommodate lower functioning students. As a result, the instructional activities in their entirety have been rewritten in a simpler language version. This simpler version can be further broken down in language and in mathematical task presentation. The original version remains to insure that the mathematical content remains intact.

Summary

Although generalizations are difficult to make regarding participating students, teacher evaluators provided information that is not inconsistent with the research reported in the introductory section of this report. The academic students at the upper

kindergarten and the lower elementary grade levels who were able to complete the program were younger than their counterparts in the other two categories of handicapping conditions who completed the program. The amount of time required for completion also was shorter for the former group. There were fewer substitutions or additions of academic students necessary for the teacher evaluators to critique the instructional activities. Among the participants, there were a number of ungraded students. However, the majority of these students who were assigned to a grade level were reported by their teachers as being below that grade level in mathematics performance. Kindergarten and lower elementary grade students appeared to be more at grade level and proceeded comfortably through the prenumber activities. Evaluation was further complicated by lack of maturation of a number of students, by educational retardation, by the time-consuming cumulative process that occurs in the building of a mathematics base on which to proceed, and by the time restrictions imposed in completing the project on schedule.

Dissemination

In October 1983 the Educational Research and Development Committee, composed of ex officio trustees of the American Printing House for the Blind, met in Louisville and approved for production the FOCUS Mathematics program, academic edition. In the spring meeting in May 1984, this Committee approved production of the multihandicapped and the deaf/blind editions. A brochure describing the programs has been circulated nationally to all residential schools for blind students and to all state departments of instruction (programs for the handicapped). Notification of availability and a materials description has been published in the American Printing House for the Blind newsletter. The programs will be included in the new edition of the American Printing House Catalog, Instructional Aids, Tools, and Supplies for the Visually Handicapped, which has national and international circulation.

A summary report of the project has been included in the Report of Research and Development Activities at the American Printing House for the Blind (1984) and circulated to ex officio trustees in the above programs for the handicapped. The names of participating experts, teacher/evaluators, and cooperating school districts were listed in the report.

It is anticipated that summarized versions of this project report will be submitted to professional journals for publication to inform mathematics teachers nationally of the availability and content of the programs.

Other dissemination activities conducted during the project are summarized below.

Workshop activities consisted of national, area, and regional workshops and of distribution of reference sets of the FOCUS materials to approximately 20 instructional resource centers for the visually handicapped throughout the United States. Letters were sent to each center offering a set of the materials with possible follow-up workshops if requested. Similar offers were made to some 20 universities with programs for training teachers of visually handicapped students that are not in areas served by or in close proximity to the above instructional resource centers. Responses were impressive with more than 70% of the centers and universities requesting sets of materials. Several expressed interest in sponsoring teacher workshops. Lists of these recipients are included in Appendix B.

Initial workshop sessions were held at the California Transcribers and Educators of Visually Handicapped Conference held March 22-24, 1984 in San Diego. The workshops were conducted to introduce the FOCUS in Mathematics program to educators and to get their suggestions for the additional sessions to be held across the country. Each workshop was divided into four parts: (a) an introduction to the program, (b) demonstrations of some of the materials in use, (c) hands-on participation, and (d) follow-up discussion and interaction among participants. Participants were asked which activity was most helpful in achieving the overall workshop objective of making teachers more comfortable in using the program. Their unanimous response was the hands-on participation. They also were unanimous in their responses that the program appears to allow flexibility for use with a broad range of students and/or to meet supplementary needs in assessment, diagnosis and prescription, and remediation. Representatives from Washington, Oregon, and Arizona attended the workshops.

Additional state, regional, and national workshop sessions held across the country include:

1. A statewide workshop in Austin for representatives of the 20 regional education service centers in Texas and for the Texas School for the Blind in April 1984.

2. A two-day workshop for the New Jersey Commission for the Blind was conducted in Newark in May 1984. More than 20 teachers were in attendance. Two participants were from New York.

3. A statewide workshop was held in Colorado with sessions conducted at the Colorado School for the Blind in Colorado Springs in September 1984.

4. A national workshop was held in Louisville at the American Printing House for the Blind Annual Meeting in October 1984.

5. A regional workshop was held in Columbia, South Carolina in November, with invitations extended to special educators from Georgia and North Carolina.

Recommendations for Future Instructional Materials Development

Teachers who used the FOCUS mathematics program with students were unanimous in their endorsement of the program. Generally, they supported and recommended the development of additional instructional materials. Variation in emphasis appeared to be based on academic level and categories of students with whom teachers worked. Following are their recommendations:

1. The development of a second level of materials proceeding from the entry level concepts to higher level activities with emphasis on fundamental operations and on computational skills was recommended. Specific modules or units which also should receive attention are: money, time, measurement, graphics, and fractions. Teachers of academic students particularly expressed the need for a "second level" following the format of the FOCUS program. These teachers indicated that many of their students were beyond the level of the program evaluated, but stated that there is a need for a program focusing on "higher level" fundamental concepts and operations. A number of the older and higher functioning deaf/blind and multihandicapped students functioned more like those students designated as academic. Teachers of these students indicated that a similar program, sequenced in small steps, would enable students with additional needs to continue to acquire and master fundamental mathematics concepts and operations.

2. The majority of teachers supported the preparation of a mathematics based daily living program. Teachers of higher functioning students indicated a greater desire for a more "mathematics" oriented program than did teachers of students of less academic potential. However, most teachers were in support of a daily living program which is curriculum based.

3. The majority of teachers supported a mathematics based prevocational program. Again, the emphasis of teachers of more academic students was on fundamental mathematics skills and operations while teachers of less academic students expressed the desirability of an "applications" oriented program which incorporates basic mathematics skills and operations into prevocational activities.

4. A number of teachers specifically indicated the need for a prevocational program or modules in mathematics for older and less academic students, with focus on the use of simple mathematics related to such activities as making purchases, using and counting money, and budgeting money. Some teacher evaluators expressed this need although the students with whom they evaluated the program were not ready for these materials.

5. Although teachers were not always specific, they suggested and projected the need for prevocational materials for the students whom they teach. Several indicated that there is a void in the availability of appropriate prevocational materials.

6. Several teachers, including those of academic students, suggested a manual for parents focusing on home-based needs. They felt that such a manual can stimulate parent interest and can extend reinforcement of basic mathematic concepts.

7. Units and/or modules in the following specific areas were recommended: counting money, time (including calendar activities), basic measurement, and introduction to interpretation of graphs.

8. The module or unit other than use of money which occurred most often was related to time. Several teachers expressed the need for a clock with a second hand.

References

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Harley, R. K., Jr. (1963). Verbalism among blind children: An investigation and analysis, (Research Series No. 10). New York: American Foundation for the Blind.

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Willis, D. H. (1980). Academic achievement of legally blind students. Louisville, KY: American Printing House for the Blind.

APPENDIX A

PARTS LIST

FOCUS in Mathematics
Kit I with Manual - Catalog Number 1-0828
Kit MH with Manual - Catalog Number 1-0830
Kit DB with Manual - Catalog Number 1-0829

Note: The listing of activities for each item is provided for instructional convenience. Items are listed according to how they are packaged.

Number Included	Item	For Activities
	Pac A	
7	Corks (2 large, 2 medium, 3 small)	1, 2
2	Caplugs	1, 13
1	Ball	1, 3, 13
1	Screw	13
1	Drawer pull	13
1	Pipe elbow	13
2	Plastic bracelets	3, 5, 13
1	Clothespin	13
6	Wheels (2 large, 2 medium, 2 small)	9, 10, 13, 14
20-30	Counting discs	2, 40
2	Sponges	13
1	Bracket	13
1	Balloon	5, 13
1	Glove	13
1	Gasket	13
1	Plastic shape	13
1	Pipe connector	13
1	Square	13
5	Cups	2, 4, 13, 101
12	Cubes	13, 101

PARTS LIST

FOCUS in Mathematics

Number Included	Item		For Activities
	Pac B		
4	Nuts		4, 39
4	Bolts		4, 39
4	Washers		4
	Pac C		
5	Knives		5, 38
5	Forks		5, 38
5	Spoons		5
	Pac D		
2	Large circles	(equal thickness)	6, 11, 15
2	Large squares	(equal thickness)	6, 11, 15
2	Large rectangles	(different thickness)	17, 18
2	Large triangles	(different thickness)	16, 18
2	Small circles	(different thickness)	7, 8, 15, 166, 167
2	Small squares	(different thickness)	7, 8, 15, 166, 167
2	Small rectangles	(different thickness)	7, 8, 11, 18, 166, 167
2	Small triangles	(different thickness)	7, 8, 11, 18, 166, 167
	Pac E		
6	Irregular shapes		12

AMERICAN PRINTING HOUSE for the BLIND P.O. BOX 6085 LOUISVILLE, KY. 40206-0085

PARTS LIST

FOCUS in Mathematics

Number Included	Item		For Activities
		Pac F	
8	Blocks	(5 sizes: 2 of each except largest and smallest)	1, 3, 10, 14 46, 47, 48, 49
		Pac H	
8	Length sticks	(1-5", 1-4", 2-3", 2-2", 2-1")	22, 23, 24, 25, 50, 51, 52, 53
		Pac I	
8	Height cylinders	(1-6", 1-5", 2-4", 2-3", 2-2")	26, 27, 28, 29, 54, 55, 56, 57
		Pac J	
8	Width bars	(1-2½", 1-2", 2-1½", 2-1", 2-½")	30, 31, 32, 33, 58, 59, 60, 61
		Pac K	
6	Weighted containers	(2-full, 2-½ full, 2-empty)	34, 35, 36, 37, 62, 63, 64
		Pac L	
22	Counting cards	(dots, triangles)	70, 83
		Pac O	
125	Craft sticks		40, 72, 75, 85, 88, 89, 106, 109, 120, 121, 128

AMERICAN PRINTING HOUSE for the BLIND P.O. BOX 6085 LOUISVILLE, KY. 40206-0085

PARTS LIST

FOCUS in Mathematics

Number Included	Item	For Activities
	Pac R	
6	Numeral cards (0-5)	78, 79, 80, 81, 82, 93, 94, 95, 96, 105, 109
	Pac U	
5	Numeral cards (6-10)	91, 92, 93, 94, 95, 96, 105, 109
	Pac V	
1	"+" Sign card	103, 105
1	"=" Sign card	104, 105, 109
1	"–" Sign card	108, 109
1	"x" Sign card	142
1	"–" Sign card	147
	Pac d	
8	Cards displaying lines	168
	Pac e	
7	Cards displaying curves	169
	Pac f	
9	Cards displaying designated points inside, on, and outside geometric figures: circles, squares, and triangles	170

AMERICAN PRINTING HOUSE for the BLIND P.O. BOX 6085 LOUISVILLE, KY. 40206-0085

PARTS LIST

FOCUS in Mathematics

Number Included	Item	For Activities
	Materials for Styrene Cards	
18	Beads for cards A-1 and A-2 (6 cubes, 6 spheres, 6 cylinders)	149
	Styrene Cards	
1	G	19, 20, 21
1 each	M-1, M-2	40, 42, 43, 66, 67
1	N-1	41, 44, 45, 69
1	N-3	41, 45, 68, 69
1	M-3	42, 43, 65, 66, 67
1	M-4	43, 65, 67
1	N-2	43, 44, 45, 68
1	N-4	43, 68, 69
1 each	Q-0 to Q-5	70, 76, 77, 79, 80, 89, 90, 93, 100, 102, 107
1	P-1	73, 114
1	P-2	74
1 each	T-6 to T-10	83, 86, 89, 90, 92, 93, 100, 118
1	S-1	87
1	O	140, 141, 143, 144, 174
1	I	146, 149
1 each	A-1, A-2	149
1	X	155

AMERICAN PRINTING HOUSE for the BLIND P.O. BOX 6085 LOUISVILLE, KY. 40206-0085

PARTS LIST

FOCUS in Mathematics

Number Included	Item	For Activities
	Styrene Cards (continued)	
1 each	Z-1, Z-2	157
1	b	166
1	c	167
1	m	172
	Brailon Sheets	
1	W	110
1	X	111
1	Y	112
1	Z	113
1	H-1	116, 119
1	H-2	116, 119
1	g	123
1	j	130
1	k	131
1	r	132
1	s	133
1	t	134
1	u	135
1	v	135
1	q	137

AMERICAN PRINTING HOUSE for the BLIND P.O. BOX 6085 LOUISVILLE, KY. 40206-0085

PARTS LIST

FOCUS in Mathematics

Number Included		Item	For Activities
		Brailon Sheets (continued)	
1	1		139
1	p		151
1	y		156

AMERICAN PRINTING HOUSE for the BLIND P.O. BOX 6085 LOUISVILLE, KY. 40206-0085

Addendum for
FOCUS in Mathematics
Parts List

Pac A should also include:

1	Toy car (metal)
1	Animal (plastic)

Pac A quantity change:

1	Sponge

Brailon Sheets should also Include:

1	Sheet n

APPENDIX B

FOCUS MATH PROJECT

PROTOTYPE/DISSEMINATION SET LOCATIONS

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Alabama			Ms. Daisy L. Roberson (2 sets) Ms. Diane McGarity Helen Keller Center Alabama Institute for the Blind Box 689 Talladega, AL 35160 Ms. Mary F. Ross (2 sets) Ms. Melba D. Fisher South-West Regional School for the Blind Route 5 Box 87 Mobile, AL 36609 Mrs. Bea Teal Barrett Elementary 7605 Division Avenue Birmingham, AL 35202
Arizona		Bess Kaplan (2 sets) Foundation for Blind Children 1201 North 85th Place Scottsdale, AZ 85257	
Arkansas	Dr. Daniel Head Rehabilitation and Special Education University of Arkansas at Little Rock 33rd & University Little Rock, AR 72204	Bob Brasher Educational Services for the Visually Impaired 2600 West Markham Little Rock AR 72203	
California	Dr. Evelyn Neufeld Dept. of Mathematics Education San Jose State University San Jose, CA 95192	Fred Sinclair Clearinghouse Depository for Handicapped Students 721 Capitol Mall Sacremento, CA 95814	Mr. Richard Morris (4 sets) Mrs. Kathleen Morris Ms. Lea Antonucci Ms. Shelley Barron Albert Schweitzer School 6991 Balboa Ave. San Diego, CA 92111

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
California (Cont'd)		Caroline Gunther Ross Elementary School San Diego Unified School District San Diego, CA	Ms. Charlotte Wood Hilltop Elementary 30 Murray St. Chula Vista, CA 92012 Mrs. Cinda Hubbard Fairmont School 724 Kearny El Cerrito, CA 94530 Mrs. Elaine Spector Ross Elementary 7470 Bagdad San Diego, CA 92111 Ms. Marsha Williams (2 sets) Ms. Karol Jump Vista Unified School District 1234 Arcadia Vista, CA 92083
Colorado		Buck Schrotberger Colorado IMC for the Visually Handicapped 1362 Lincoln Street Denver, CO 80203	
Delaware		Lynne Young Division for the Visually Impaired 305 West 8th Street Wilmington, DE 19801	
District of Columbia			Ms. Paulette Willis D. C. Vision Programs Tyler Elementary 18th & 6 Streets Washington, D. C. 20004

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Florida		Dr. Tuck Tinsley III (2 sets) Gerry Vandergrift Florida School for the Deaf and the Blind Box 1209 San Marco Avenue St. Augustine, FL 32084 Carolyn Leitch Conklin Center 405 White Street Daytona Beach, FL 32014	Ms. Sandi Driben Florida School for the Deaf and the Blind Box 1209 San Marco Avenue St. Augustine, FL 32084
Georgia	Dr. Ken Ricker Dept. of Science Education University of Georgia Athens, GA 30602		Ms. Claire Sullivan (2 sets) Ms. Lee Ann Meadows Atlanta Area School for the Deaf 890 North Indian Creek Drive Clarkston, GA 30032 Ms. Wendy DeLeon Laurel Ridge Elementary 1215 Balsam Drive Decatur, GA 30033
Illinois	Dr. Gaylen Kapperman Dept. of Learning, Development, and Special Education Northern Illinois University DeKalb, IL 60115 Dr. Evelyn Rex Program in Vision Impairment 321 Fairchild Hall Illinois State University Normal, IL 61761		

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Iowa		Ronald Fistler Instructional Services Center Iowa Braille & Sight Saving School 1002 G Avenue Vinton, IA 52349	
Kentucky		Sue Enoch (2 sets) Kentucky School for the Blind 1841 Frankfort Avenue Louisville, KY 40206	
Louisiana		Carol Wines Louisiana Learning Resources System 2525 Wyandotte St. Baton Rouge, LA 70805	Ms. Angelyn Mills (2 sets) Mrs. Alice Stabinsky E. B. White Elementary 3519 Trafalgar St. New Orleans, LA 70119 Ms. Karen Gautheir Harahan Elementary 6723 Jefferson Freeway Harahan, LA 70123
Massachusetts			Ms. Laurie Wasserman (2 sets) Ms. Carol Crook Perkins School for the Blind 175 North Beacon St. Watertown, MA 02172
Michigan	Dr. Lou Alonso College of Education Michigan State University East Lansing, MI 48824		

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Minnesota	Dr. Marie Knowlton Dept. of Educational Psychology University of Minnesota 178 Pillsbury Dr. Minneapolis, MN 55455		
Nebraska		Donna McKinley Nebraska Dept. of Education P. O. Box 94987 Lincoln, NE 68509	
New Hamphire		Lynne Albright N.H. Educational Services for the Visually Handicapped 175 South Fruit St. Concord, NH 03301	
New Jersey		Pete Rossi N.J. Commission for the Blind 232 Frelinghuysen Ave. Newark, NJ 07114	
New Mexico		Bill Davis New Mexico School for the Visually Handicapped 1900 North White Sands Alamogordo, NM 88310	
New York			Ms. Ollie Cummings New York Institute for the Blind 999 Pelham Parkway Bronx, NY 10469
North Carolina	Dr. Alana Zambone Dept. of Curriculum & Instruction North Carolina State University 402 Poe Hall Raleigh, NC 27650		

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Ohio	Dr. Marjorie Ward Dept. of Human Services Education Ohio State University 154 West 12th Avenue Columbus, OH 43210	Julie Todd Ohio Resource Center for Low Incidence and Severely Handicapped 470 Glenmont Avenue Columbus, OH 43214	
Oregon		Linda Schmoldt Oregon Textbook and Media Center for the Visually Handicapped 531 S.E. 14th St. Portland, OR 97214	
Pennsylvania	Dr. Ralph Peabody Dept. of Special Education University of Pittsburg Pittsburg, PA 15260	Frances Warkomski (3 sets) Technical Assistance for Sensory Impaired Programs 150 South Progress Avenue Harrisburg, PA 17109	Ms. Cathy Futryk West Pennsylvania School for Blind Children Bayard at Bellefield Pittsburg, PA 15213
South Carolina	Dr. Sandy Parsons (2 sets) Program for Exceptional Children College of Education University of South Carolina Columbia, SC 29208		
Tennessee	Dr. Randall C. Harley Dept. of Special Education George Peabody College of Vanderbilt University Nashville, TN 37203		
Texas	Dr. Anne L. Corn Dept. of Special Education University of Texas at Austin Austin, TX 78712 Dr. E. Glenadine Gibb Dept. of Mathematics Education University of Texas at Austin Austin, TX 78712	Janie Jones Texas Education Agency 201 East 11th Street Austin, TX 78701 Texas School for the Blind 1100 West 45th Street Austin, TX 78756	Mrs. Cyral Miller (2 sets) Ms. Debra Leff Reilly Elementary 405 Denson Austin, TX 78752 Ms. Larinda Wagenhouser Kaiser Elementary 13430 Bammel, North Houston Houston, TX 77066

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Texas (Cont'd)		Ms. Yvonne Hylander Region I Education Service Center 1900 West Schunior Edinburg, TX 78539 Ms. Joyce West Region II Education Service Center 209 North Water Street Corpus Christi, TX 78401 Ms. Eleanor Oliver Region III Education Service Center 1905 Leary Lane Victoria, TX 77901 Dr. Frances Stetson Region IV Education Service Center 7200 West Tidwell Road P. O. Box 863 Houston, TX 77001 Ms. Jamie Baggett Region V Education Service Center 2295 Delaware Street Beaumont, TX 77703 Dr. Ouida Fae Morris Region VI Education Service Center 3332 Montgomery Road Huntsville, TX 77340 Ms. Diana Montgomery Region VII Education Service Center 818 East Main Street P. O. Drawer 1622 Kilgore, TX 75662	

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Texas (Cont'd)		VH Component Region VIII Educational Service Center 100 North Riddle Street Mount Pleasant, TX 75455 Ms. Ann Moore Region IX Education Service Center 301 Loop 11 Whichita Falls, TX 76305 Ms. Elizabeth Jeffrey Region X Education Service Center 400 E. Spring Valley Road P. O. Box 1300 Richardson, TX 75080 VH Component Region XI Education Service Center 3001 North Freeway Fort Worth, TX 76106 Ms. Ann Rash Region XII Education Service Center 401 Franklin Avenue P. O. Box 1249 Waco, TX 76703 Ms. Elaine Moses Region XIII Education Service Center 7703 North Lamar Austin, TX 78752 Ms. Marci Thwing Region XIV Education Service Center 1850 State Highway 351 Rt. 1, Box 70A Abilene, TX 79604	

State	Teacher Training Programs	Instructional Material/ Resource Centers	Field Test Sites
Texas (Cont'd)		Ms. Cindy Lubke Region XV Education Service Center 612 South Irene P. O. Box 5199 San Angelo, TX 76902 Ms. Eileen Burke Region XVI Education Service Center 1601 South Cleveland P. O. Box 30600 Amarillo, TX 79120 Ms. Dixie McNeil Region XVII Education Service Center 4000 22nd Place Lubbock, TX 79410 Ms. Sheryl Stretcher Region XVIII Education Service Center LaForce Boulevard P. O. Box 6020 Midland, TX 79701 Ms. Olivia Schonberger Region XIX Education Service Center P. O. Box 10716 El Paso, TX 79997 Ms. Nancy Toelle Region XX Education Service Center 1314 Hines Avenue San Antonio, TX 78208	
Virginia	Dr. Don L. Walker University of Virginia Room 152, Ruffner Hall 405 Rummet Street Charlotteville, VA 22903		